1 419 850

PATENT SPECIFICATION

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(19)

(54) A COUPLING FOR WELL COMPLETION EQUIPMENT

(71) We, McEVOY OILFIELD EQUIPMENT CO., a Pennsylvania partnership, of 400 North Lexington Avenue, Pittsburgh, State of Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a coupling for well completion equipment and more particularly to a coupling for connecting a hydraulic line to a tubing valve for operating the valve.

In well completion equipment it is often found necessary to actuate a mechanism, such as a valve or the like, disposed within the well. The actuating means is generally powered by a hydraulic fluid in a pipe line or conduit extending down to the mechanism from the top of the well, e.g. from a source of pressurized hydraulic fluid on or above a water platform in the case of a subsea well.

It is known to provide a valve in a well tubing string to close the flow passage through the tubing, e.g. in case of accident necessitating shutting off the flow from the well through the tubing. Such a valve may be spring biased or pressure differential biased toward the closed position. The valve may be moved to its open position by actuating means powered by the hydraulic fluid. If the hydraulic fluid pressure fails for any reason, e.g. if the platform is blown away in a hurricane, the tubing valve moves to its closed position, shutting in the well.

The hydraulic fluid conduit that extends from the tubing valve to the top of the well is usually a small diameter pipe, e.g. 1/2" to 1" in outer diameter, disposed outside of the tubing and parallel thereto. Heretofore, such hydraulic conduit or pipe has been screwed into a socket in the lower end of a longitudinal passage extending up through the body of the tubing hanger. By suitable means such passage is continued upwardly to a level above the tubing head top flange into the master valve or valve adapter spool. At that level the hydraulic fluid passage has been connected to a port extending transversely, e.g. radially, out through the lower flange of the tree element (valve or spool). A hydraulic fluid line coming from a source of fluid under pressure is screwed into a screw threaded socket at the outer end of such transverse port.

In the case of a multiple parallel tubing string completion the aforementioned means for making connection between the hydraulic fluid passage extending up through the tubing hanger and the transverse port in the tree element flange includes for each tubing string a short pipe nipple integral with or screwed into the tubing hanger at the upper end of the hydraulic fluid passage through the tubing hanger. This hydraulic fluid nipple extends up through the sandwich seal that packs off, between the flow nipple and tubing hanger. The hydraulic fluid nipple extends upwardly into and seals with a vertical socket in the lower face of the tree element, which socket connects with the transverse port in the valve element flange. Alignment means is provided between the tubing head and hanger such that when the tree element is positioned on the tubing head with the bolt holes of the respective tree and head flanges in register, the hydraulic fluid nipple can be in alignment with the vertical socket in the tree element that is to telescope thereover.

The above described coupling between the hydraulic fluid transverse passage in the tree element flange and the hydraulic fluid passage extending longitudinally up through the tubing hanger has been modified to omit the need for alignment means in the case of a single tubing well completion. The wall of the flow nipple in a single tubing completion is made thick enough so that the hydraulic fluid passage in the tubing hanger body can be continued up into the flow nipple to the level of the tree element. At that level, the hydraulic fluid passage in the

flow nipple is extended transversely, e.g. radially, horizontally, outwardly to an annular groove around the flow nipple. Such groove is located so as to be at the level of the transverse passage in the tree element flange. Annular seal rings around the tubing nipple above and below the annular groove provide means to seal the connection between the radial passage and the annular groove.

In all of the above described constructions there exists the objection that if the tree is not in position, there is no way to connect the hydraulic fluid conduit in the well with the source of pressurized hydraulic fluid whereby the tubing valve can be opened. Thus, when tubing is run in through blowout preventers mounted on top of the tubing head, it is necessary to omit the tubing valve if any operations are to be conducted through the tubing requiring an open passage through the tubing. The tubing valve must be installed later, e.g. run in on a wire line, and can be opened only when the blowout preventers have been removed and the tree has been installed.

In order to overcome these problems it is possible to provide a transverse, e.g. radial, bore for hydraulic fluid in the side of the tubing head at the level of the tubing hanger body below the flow nipples and sandwich pack off that surmount the hanger body, and providing means to connect such transverse bore in the tubing head with the longitudinal, e.g. vertical hydraulic fluid passage in the tubing hanger body. Such constructions are described and claimed in the specification of co-pending British patent application No. 21468/73. (Serial No. 1419849).

This latter means generally is in the form of conduit which is passed through the tubing head bore and is engaged in fluid tight relationship with a transverse, e.g. radial passage in the side of the tubing hanger body. The transverse passage converts with the longitudinal vertical passage extending downwardly to the lower face of the hanger body.

However, such constructions are rather rigid and do not adequately provide sufficient elasticity to allow for movement between a tubing head and a tubing hanger.

According to the present invention there is provided a coupling for providing flow communication through a first member from a second member having correlative transverse passages therethrough which are misalignable, comprising a conduit adapted for longitudinal insertion into the passage of the first member, attachment means for attaching said conduit in flow communication with the second member; an enlarged bore within the passage of the first member to permit bending of said conduit, and retaining means on said conduit other than said attachment means for retaining said conduit in the passages under pressure.

Preferably, the conduit is sealingly secured to the tubing head bore by means of a compressible seal. The use of the compressible seal permits the conduit to be off-centre within the tubing head bore and still provide a sealing connection.

Another advantage of the present coupling is the use of a metal-to-metal seal between the coupling and the tubing hanger.

A further advantage is a collar around the conduit to prevent the conduit from blowing out of the tubing head bore.

Another connection means may be in the form of a retractable stinger in the transverse bore and engageable in fluid tight relationship with the transverse passage. As in the prior art constructions, the lower end of the vertical passage in the tubing hanger terminates in a socket to receive the hydraulic fluid conduit that extends down to the safety ball valve in the tubing.

The just described form of connection means requires that the tubing hanger be aligned with the tubing head so as to place the transverse bore in the tubing head in register with the transverse passage in tubing hanger. However, in the case of multiple parallel string completions such alignment means is required in any event in order to place in registry the bolt holes on the tubing head flange and the tree (e.g. multiple valve) flange when the sockets in the latter are placed over the tubing flow nipples. Also, such alignment means is present even in the case of single completion hangers if the latter are of the currently popular type employing retractable lock screws to support all or part of the lead on the tubing hanger.

In the case of parallel string multiple completion hangers, wherein the hanger is split, each of the transverse passages in the tubing hanger is located at a part of the hanger body where there is adequate material to provide for a sealing connection with the stinger, in other words, in the part of the body of the hanger to one side of the main flow passages therethrough.

Other objects and advantages of the invention will appear from the following description of preferred embodiments thereof, reference being made for illustration to the accompanying drawings.

Figure 1 is a vertical section through a tubing head and tubing hanger construction;

Figure 2 is a horizontal section taken at plane 2—2 of Figure 1;

Figure 3 is a vertical section to a larger scale, taken at plane 3—3 of Figure 2;

Figure 4 is a vertical section, partly in elevation, similar to Figure 3 showing a modification; and

Figure 5 is a vertical section, partly in elevation, of a coupling according to the present invention.

Referring now to Figure 1 there is shown a well-head structure which is also disclosed in our copending British Application No. 21468/73 (Serial No. 1419849) and which includes a tubing head 11 surmounting a casing head 13 (shown only fragmentarily). A lower flange 15 of the tubing head is secured to an upper flange 17 of the casing head by bolts 19 and sealed thereto by ring gasket 23. The casing head 13 may surmount further casing heads (not shown), the stack of casing heads being flanged or in other manner connected together in any known manner as desired.

Surmounting the well-head structure is a tree including, for example, as a lower element thereof, a plural (e.g. dual) bore valve 25. A lower flange 27 of the valve 25 is secured to an upper flange 29 of the tubing head by bolts 31 and nuts 33.

Between the flanges 15 and 29 of the tubing head its generally tubular body is provided with ports 34, 35 through which fluids can be introduced into and withdrawn from the tubing head. Around the ports 34, 35, there are bosses 36, 32 to receive cap screws by which connections can be made to the ports 34, 35, or by which cover plates can be secured thereover.

In the upper part of the tubing head there is an annular shoulder 37 on which are supported the sectors 39, 41 of the split body of multiple (e.g. dual) bore tubing hanger 43. Integral with the sectors 39, 41, respectively and extending downwardly therefrom are tubular couplings 45, 47. Tubing strings 49, 51 are supported from the hanger 43 by virtue of the upper ends of the strings being screwed into the couplings 45, 47.

In the tubing strings are connected ball valves 53, 55 biased to closed positions by springs or pressure differential and moved to open position by hydraulic pressure. Such valves are well known, being shown for example, at page 3883 of the Composite Catalogue of Oil Field Equipment and services, 1970—71 Edition. Extending upwardly from the valves 53, 55, are pipes 57, 59 for hydraulic fluid under pressure, the pipes constituting hydraulic control lines for the valves 53, 55. These lines extend upwardly alongside the tubing strings 49, 51 and are screwed into sockets in the lower ends of the sectors 39, 41 of the tubing hanger body. The sockets are at the lower ends of vertical fluid passages 56, 58 (described in more detail hereinafter) which extend upwardly in the hanger sectors and connect to transverse fluid passages 61, 63 extending out to the sides of the hanger sectors.

Referring now to Figure 2, the passages 61, 63, receive therein retractable tubular stingers 65, 67, (described in more detail hereinafter), which connect to hydraulic fluid lines 69, 71. The lines 69, 71 lead to a suitable source of pressurized hydraulic fluid (not shown) and to valve means for admitting such fluid to the lines and exhausting it therefrom as is required to open and close tubing valves 53, 55.

The sectors 39, 41 are held in predetermined azimuthal position in the tubing head 11 by alignment means comprising retractable lock screws 73, 75. These lock screws also retain the hanger sectors on the seats provided by annular shoulder 37 and may support some of the weight and pressure on the hanger body. The sectors 39, 41 respectively have flow passages 77, 79 therethrough which connect with the couplings 45, 47 at the lower ends of the sectors.

As best shown in Figure 2, the hanger sectors 39, 41 are provided with wings 39A, 39B, 41A, 41B at the sides of the flow passages 77, 79. The control fluid passages 56, 58, 61, 63 are located in the wings 39B, 41B.

Referring once again to Figure 1, there are tubular seal couplings 81, 83 integral with and extending upwardly from the hanger sectors 39, 41 in fluid flow relationship with the flow passages 77, 79 through the hanger sectors. Flow nipples 85, 87 are screwed into the couplings 81, 83 in fluid tight relationship and extend upwardly into sockets 89, 91 in the bottom of the dual bore valve 25 to which they are sealed, e.g. by O-rings or by a suitable dual bore packing gland.

When the well is flowing, oil or gas flows upwardly through tubing strings 49 and 51 and the valves 53, 55 into hanger couplings 45, 47, and thence through flow passages 77, 79 in the hanger sectors 39, 41 and seal couplings 81, 83 into flow nipples 85, 87 and into the dual bore valve, the fluid flow being sealed off from the annulus 101.

Fluid flow in the annulus past the tubing hanger is blocked off by hanger seal 103 comprising metal base plate 105, rubber seal disc 107, and compression plate 109, all of which have two holes therein through which extend seal couplings 81, 83. Retractable lock screws 111, 113, (and others not appearing in the drawing) extend radially through flange 29 and engage the bevel 115 at the outer upper edge of compression plate 109 to wedge it down and compress seal disc 107 into sealing engagement with the seal couplings 81, 83 and the inner periphery of the tubing head 11.

The hanger couplings 45, 47 are adapted to receive retrievable back pressure valves (check valves closing to prevent upward flow) not shown.

Except for the hydraulic control fluid passage means the tubing head and hanger just described are the same as the type R equipment described on page 4196 of the 1971 edition of the Composite Catalogue of Oilfield Equipment and Service and more fully on page 20 of the Rockwell Manufacturing Company catalogue V-404.

Referring now to Figure 3 there is shown in more detail the hydraulic control fluid passage means. In the tubing head 11 is suspended sector 39 of the tubing hanger, same being hung on support shoulder 37. Tubing 49 is connected to hanger coupling 45. Control line 57 is screwed into threaded socket 125 in the lower face of the hanger sector, whereby it is placed in communication with vertical passage 56 extending upwardly therefrom. Vertical passage 56 connects to radial passage 61 near the upper part of the hanger sector, within the wing 39B below seal coupling 81.

The radial passage 61 is enlarged by counterbores 126, 127. A shoulder 128 is formed between the counter-bores. Counterbore 126 receives the reduced diameter end 129 of stinger 65. Counterbore 127 receives packing material rings 131, 133, junk ring 135 and compression ring 136 which provide means to seal between the stinger and hanger sector wing. Junk ring 135 bears against shoulder 128. Compression ring 136 receives thrust from shoulder 137 at the juncture of the reduced diameter end 129 of the stinger and the main body 139 of the stinger. Prior to assembly with the tubing hanger the rings 131, 133, 135, 136 are held on the end of the stinger between shoulder 137 and split ring 140 snapped into a groove in the end of the stinger.

The main body of the stinger is provided with an enlargement 141 which is exteriorly screw threaded. The enlargement 141 is screwed into screw threaded passage 143 in the tubing head 11. Passage 143 is formed in boss 145 on the side of the tubing head.

From the foregoing it is apparent that stinger 65 is a tubular screw, threaded through the tubing head into the tubing hanger and compressing the packing 131, 133, to seal between the end of the stinger and the tubing hanger passage 61. The flow passage 150 through the stinger is thus sealed in fluid flow relationship with passage 61 in the tubing hanger.

Instead of compressible packing material rings the seal could be effected by means of O-rings, in which case the junk and compression rings could be omitted.

The stinger is held in place in the tubing head by means of the screw threads on enlargement 141 and passage 143. The outer end of the stinger is interiorly screw threaded at 148 for connection to a hydraulic line 69.

To seal between the stinger and the tubing head, passage 143 is provided with counterbores 151, 153. Counterbore 153 is screw threaded and receives a gland nut 155 which is screwed therein. Between the inner end 157 of the gland nut and shoulder 159 at the inner end of counterbore 151 is received packing means including compression ring 161, packing material rings 163, 165, 167 and junk ring 169. By screwing in the gland nut the packing material rings are compressed to seal between the stinger and the tubing head.

In the use of the above described apparatus, the stingers will be retracted until the tubing hanger sectors have been landed in the tubing head. The tubing hanger will be azimuthally aligned by lock screws 73, 75 serving as alignment means co-operating with the bevel groove 170 formed in the hanger sectors. With the hanger sectors in place and held down by lock screws 111 and 113 acting through sandwich seals 105, 107, 109, the stingers are extended into the tubing hanger sectors in fluid flow relationship with the hydraulic control fluid passages 61, 63. The valves 53, 55 can then be opened hydraulically so that whatever operations desired can be performed therethrough. At this time the blowout preventer may be removed prior to attachment of the master valve 25, the tubing hanger having been lowered through the preventer. With the master valve and tree in place, the well may be used. Should the above described completion apparatus be broken off of the tubing strings, the hydraulic control lines 57, 59 will be broken off too and valves 53, 55 will automatically shut in the well.

Referring now to Figure 4 there is shown another embodiment which eliminates the need for azimuthal alignment of the tubing hanger with the tubing head and is especially useful for single completions. The Figure 4 construction is the same as that of Figure 3 except that a single bore tubing hanger is used, alignment groove and lock screws are omitted, and the hydraulic control fluid passage means is modified. The single bore tubing hanger 175 is provided with an integral hanger coupling 177 into which tubing 176 is screwed. The hanger is supported on shoulder 179 of the tubing head 181 and is held down by lock screws 183 through sandwich packoff 185.

Around the body of the hanger there are upper and lower isolation seal annular grooves 187, 189 in which are received O-rings 191, 193. The latter seal between the

body of hanger 175 and the interior of tubing head 181.

Between isolation seal grooves 187, 189 the tubing hanger is provided with annular flow passage groove 195. Groove 197 communicates through radial passage 197 and vertical passage 199 with socket 201 in the lower face of the body of hanger 175. Hydraulic control line 203 is screwed into socket 201.

Regardless of the azimuthal position of hanger 175, annular passage 195 will be in communication with port 205 in the tubing head. Port 205 extends through boss 200 at the side of the tubing head. The outer end of port 205 is interiorly screw threaded at 207 for connection to a hydraulic control fluid line 209.

It will be apparent that in the Figure 4 embodiment the same as in the Figures 1 to 3 embodiments, the hydraulic fluid passage means is connected without reference to the present or absence of the blowout preventer or the master valve of the tree. It is therefore possible, as with the Figures 1 to 3 embodiments, to install the tubing shut off valve when the tubing is run in through the preventer and to move the shut off valve to open position as may be required for other operations prior to removing the preventer and installing the valve and tree.

The construction of Figure 4 could be adapted to split hangers for multiple completions by carrying the isolation seals completely around each hanger sector and jointing the upper and lower seals on each sector over the area where the sectors abut. Compare the packoff seals shown in United States patent specification number 2,794,505.

Instead of joining the upper and lower seals, additional sets of upper and lower seals could be provided at different levels, each, each set with a tubing hanger control fluid passage arcuate groove there-between, for connection to tubing head passages at different levels.

Tubing hanger constructions employing integral bowls receiving a plurality of hanger nipples could conceivably be adapted to the present invention, e.g. by employing Figure 3 type stingers in the tubing head entering radial passages in the bowl, the bowl passages being connected to the hanger nipples by isolation seals similar to the Figure 4 construction, but the construction must be adapted to pass the shut off valves and control tubing, e.g. as in United States patent specification number 2,830,665, with appropriate modification and relocation of the isolation seals.

Referring now to Figure 5 there is shown a preferred embodiment of a coupling in accordance with the invention. Transverse fluid passage 61 is aligned or registered with horizontal bore 310 passing from the internal periphery of tubing head 11 to the external periphery of head 11. Bore 310 is formed in boss 145 on the side of tubing head 11. Bore 310 further includes a counterbore 312 (to be discussed later) adjacent the external periphery of head 11 creating annular shoulder 344. Internal screw threads 314 are provided on a portion of counterbore 312.

A hydraulic control fluid passage means or control line exiting coupling 300 is mounted within bore 310 of head 11 to link transverse fluid passage 61 with hydraulic fluid line 69. Line 69 leads to a suitable source of pressurized hydraulic fluid (not shown) and to valve means for actuating the mechanism disposed within the well.

The coupling 300 includes flow means as for example conduit 302 for providing fluid tight communication between fluid passage 61 and hydraulic fluid line 69. Conduit 302 passes through bore 310 for sealing connection to fluid passage 61 at its mouth or outlet 308. The sealing connection between conduit 302 and hanger 43 provides a metal-to-metal seal. One such connection means includes externally tapered pipe screw threads 304 on the interior end 316 of conduit 302 threadingly and sealingly engaging internally tapered pipe screw threads 306 in outlet 308 of passage 61.

Bore 310 has a diameter sufficiently large to permit the alignment and registry of outlet 308. The diameter of bore 310 may be dictated by the general margin of error generally encountered in such an operation. It is, of course, the purpose of the present invention to avoid the requirement that bore 310 and passage 61 have coincident longitudinal axes before passage 61 and line 69 can be properly linked in fluid tight relationship and before coupling 300 can be sealingly secured with tubing head bore 310.

Conduit 302 provides one means of avoiding the alignment problem. Conduit 302 is made of a ductile material such as steel. This ductile material is as flexible as possible and yet still has the strength and corrosive resistance to handle the internal pressures and corrosion caused by the hydraulic fluid. The greater the flexibility, the easier the linkage between passage 61 and line 69 through the bending of conduit 302 between outlet 318 and shoulder 344 to permit conduit 302 to have one portion coaxial with passage 61 and another portion coaxial with counterbore 312.

In the above couplings which are also described in our co-pending British patent application No. 21468/73 (Serial No. 1419849) no clearance is provided between the interior of bore 310 and the periphery of conduit 302 to permit any bending of conduit 302 within bore 310. Further even if

such a clearance existed, there was insufficient distance between the connection of the conduit 302 to tubing hanger 43 and the connection of the conduit 302 to tubing head 11. The apparatus provides such clearances and distances to permit conduit 302 to flex between those connections. The clearance between bore 310 and conduit 302 and the distance between the hanger connection and the head connection are only limited by the size of boss 145.

A second means of resolving the alignment problem is a securement means provided sealingly to secure conduit 302 within bore 310 even though conduit 302 is off-centre and is not coaxial with couterbore 312. The securement means includes a packoff assembly 320 which has a common bore 328 of a diameter slightly larger than the outside diameter of conduit 302. Packoff 320 includes packing 326, such as a rubber ring, sandwiched between float rings 322, 324. Packoff 320 is inserted into counterbore 312 to circumscribe conduit 302. Rings 322, 324 have an outside diameter substantially less than the inside diameter of counterbore 312. This permits rings 322, 324 to fit snugly around conduit 302 and yet allow conduit 302 to be secured off-centre within bore 310 since rings 322, 324 will not prevent a misalignment of conduit 302 within bore 310 due to a premature engagement of the periphery of rings 322, 324 and the interior of counterbore 312. The securement means does not fix conduit 302 within counterbore 312 but permits conduit 302 to float or slip within the securement means upon the application of sufficient force. However, the securement means does provide a frictional engagement between conduit 302 and packing 326.

A compression means, as for example a gland nut 330 having external screw threads 332 for threaded engagement with screw threads 314 of counterbore 312, is provided to compress packoff 320 sealingly to secure conduit 302 within bore 310. Nut 330 has a central core 336 for passage of nut 330 around conduit 302. Nut 330 further includes a plurality of wrench surface 338 on the end opposite screw threads 332 for the rotation of nut 330.

Since rings 322, 324 have an outer diameter substantially less than the inner diameter of counterbore 312 permitting the misalignment of conduit 302 within bore 310, upon compression of packing 326 between rings 322, 324, packing 326 is extruded over the top of rings 322, 324. Means for containing packing 326, as it extrudes over rings 322, 324, is required to maintain a sealing force normal to the inner surface of counterbore 312. As packing 326 is compressed it will extrude in every unbounded direction, and if it is permitted to extrude horizontally without containment, there will be no radial sealing force to achieve a satisfactory sealing engagement with the inner surface of counterbore 312. Therefore the annular spaces at 323 and 325 are necessarily made small so that packing 326 can extrude into those annular spaces and yet have sufficient compression remaining to further compress packing 326 radially to provide an adequate sealing engagement with the inner surface of counterbore 312. Since rings 322, 324 have an outer diameter substantially less than the inner diameter of counterbore 312, rings 322, 324 have a small thickness as compared to the thickness of packing 326 to reduce the volume of annular spaces at 323 and 325 and to achieve the desired objective. Shoulder 344 contains the extrusion of packing 326 over ring 324. However, to contain packing 326 over ring 322, it is necessary to plug the annular space around the periphery of ring 322. This may be done by projecting the inner end of gland nut 330 beyond the terminus of threads 314 or by providing a plug such as bearing ring 334. In either case the outer periphery of the projection or ring slidingly engages the inner surface of counterbore 312.

In the embodiment of Figure 5 bearing ring 334 is inserted over conduit 302 and into counterbore 312 prior to the engagement of gland nut 330 primarily as a means to contain packing 326 but also as a means to reduce the friction between nut 330 and ring 322. As nut 330 is rotated threadingly to engage tubing head screw threads 314, bearing ring 334 bears against float ring 322 and shoulder 344 receives the thrust from float ring 324. Packoff 320 therefore contracts causing packing 326 to expand into sealing engagement between the interior of counterbore 312 and the external surface of conduit 302 thereby sealingly securing conduit 302 to tubing head 11. The distance between shoulder 344 and inlet 318 in bore 310 and the clearance between the interior of bore 310 and the periphery of conduit 302 provide space for conduit 302 to bend and flex within bore 310.

It is preferred that flexible conduit 302 and the securement means be used together rather than independently of each other, but it should be understood that the use of one does not require the use of the other. If they are used together, a successful connection will be obtained under a maximum of adverse conditions than if used separately. Together the securement means will provide a means for centering flexible conduit 302 within counterbore 312. Also using them together will not require conduit

302 to be coaxial with counterbore 312 thereby requiring an excessive bending of conduit 302 at shoulder 344 to obtain a good seal.

A collar 342 may be disposed on the external periphery of conduit 302 between shoulder 344 and inlet 318. Collar 342 has an outer diameter slightly larger than the inner diameter of float ring 324. A shoulder 343 is created between collar 342 and conduit 302 which will engage float ring 324 if conduit 302 slips radially within packoff 320. Collar 342 provides a means for removing packoff 320 upon disassembly of coupling 300. Further collar 342 is a safety feature by providing means for preventing conduit 302 from blowing out of bore 310 under pressure if the connection at outlet 308 breaks or if conduit 302 breaks between the collar 342 and inlet 318. This portion of the conduit is a critical portion since much stress and strain will be placed on it during assembly.

In the use of the above described apparatus shown in Figure 5, the tubing hanger 43 is landed in the tubing head 11. Hanger 43 is azimuthally aligned within tubing head 11 by lock screws. With hanger 43 in place and held down with lock screws, conduit 302 is inserted into bore 310 and threadingly engaged and sealed to outlet 308 of passage 61. The packoff 320 and bearing ring 334 are inserted into counterbore 312 and nut 330 compresses gland 320 for sealing securement between head 11 and conduit 302. Hydraulic line 69 is attached to conduit 302 such as by screw threads 346. The mechanism within the well may then be operated hydraulically.

Further, while the preferred embodiment has been described in the environment of well completion apparatus, it should be realized that the coupling of the present invention could be utilized as a coupling for plumbing fixtures, hose connections, electrical conduit and cable connectors, and other types of conduit connections.

The coupling is adapted for use not only with single and dual, but triple, quadruple and other higher multiple parallel string completions.

WHAT WE CLAIM IS:—

1. A coupling for providing flow communication through a first member from a second member, the members having correlative transverse passages therethrough which are misalignable, comprising a conduit adapted for longitudinal insertion into the passage of the first member, attachment means for attaching said conduit in flow communication with the second member; an enlarged bore within the passage of the first member to permit bending of said conduit; and retaining means on said conduit other than said attachment means for retaining said conduit in the passages under pressure.

2. A coupling as claimed in claim 1, wherein said means for retaining the conduit comprises securement means for sealingly securing said conduit within said first member, said securement means being located at a distance from said attachment means to permit said conduit to flex within the passages between said attachment means and said securement means.

3. A coupling as claimed in claim 2, wherein said means for retaining the conduit further comprises a collar on said conduit between the attachment and securement means, which collar also serves to facilitate the removal of said securement means from the passage of the first member.

4. A coupling as claimed in claim 2 or 3, wherein said securement means includes seal means for sealingly engaging the first member and said conduit and compression means for compressing said seal means.

5. A coupling as claimed in claim 4, wherein said securement means includes means for reducing friction between said seal means and said compression means upon the compression of said seal means.

6. A coupling as claimed in claim 5, wherein said means for reducing friction comprises a bearing ring.

7. A coupling as claimed in any of claims 2 to 6, wherein said securement means further comprises a packing compression shoulder defining an end wall of a counterbore in said enlarged bore of the first member, an annular nut constituting the compression means threadedly received in said counterbore and spaced away from said shoulder, and an annular packing, constituting the seal means, between said nut and said shoulder, said packing being compressible enough to seal against both said conduit and peripheral surface of said counterbore even when they are axially misaligned.

8. A coupling as claimed in claim 7, further comprising annular ring members adapted for circumscribing said conduit and having an outer diameter substantially less than the inner diameter of the counterbore of the first member, said packing being disposed between said annular ring members and said annular nut for compressing said packing between said annular ring members causing said packing to extrude over the periphery of said annular ring members; and means for containing the extrusion of said packing to provide adequate sealing engagement between said packing, said conduit, and the first member.

9. A coupling as claimed in claim 8 when dependent on claim 3, wherein the collar

intermediate the attachment means and one annular packing ring of the securement means, has a larger diameter than the internal diameter of the annular packing ring, thereby to facilitate the removal of the securement means.

10. A coupling as claimed in any of the preceding claims, further comprising a flexible connector defining the conduit for insertion into the bore of the first member, said connector having an outside diameter substantially less than said enlarged bore and means for positioning said connector within the first member in a plurality of azimuthal positions.

11. A coupling as claimed in any of the preceding claims, wherein the attachment means comprises a screw threaded portion on the conduit for effecting a metal-to-metal seal with the second member.

12. A coupling as claimed in any of the preceding claims, wherein the first member comprises a tubing head and the second member comprises a tubing hanger, the tubing head and hanger constituting part of a well completion apparatus.

13. A coupling as claimed in claim 1 substantially as hereinbefore described with reference to Figure 5 of the accompanying drawings.

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4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1

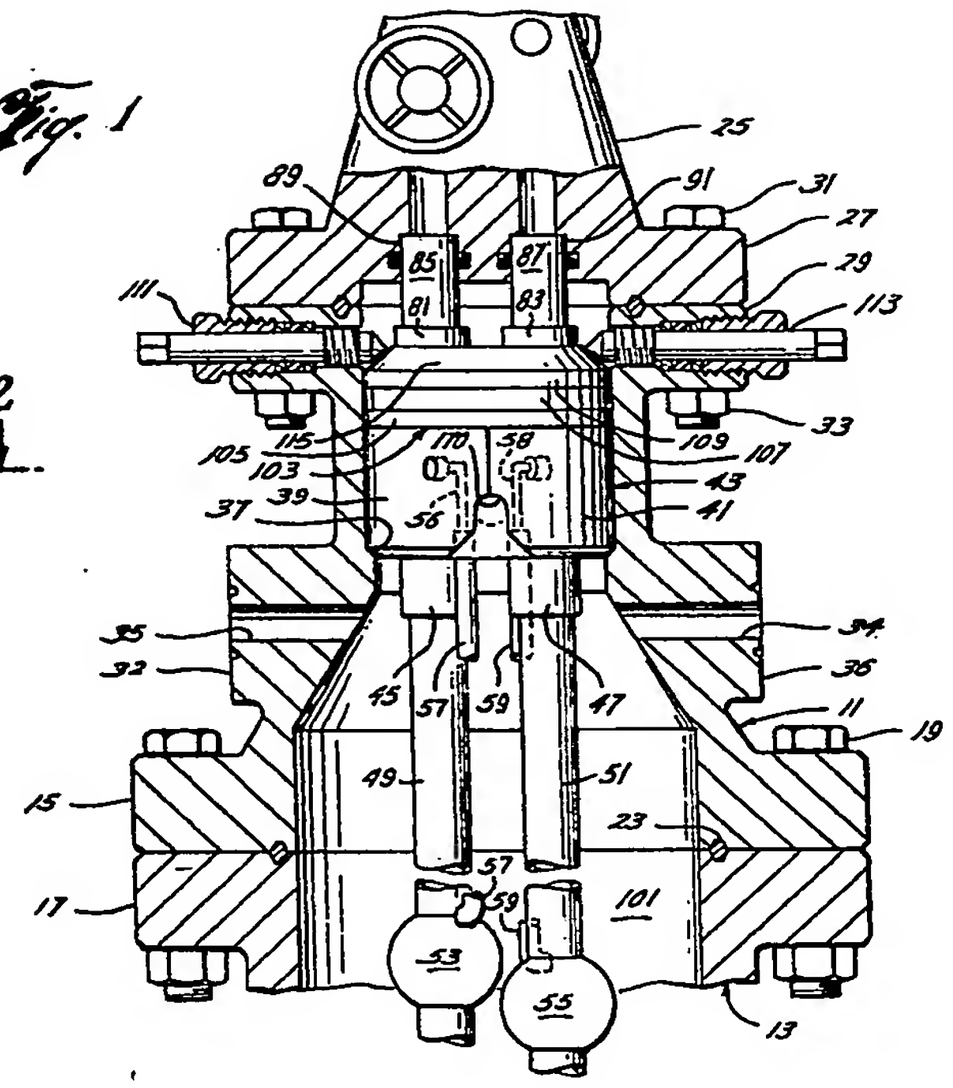
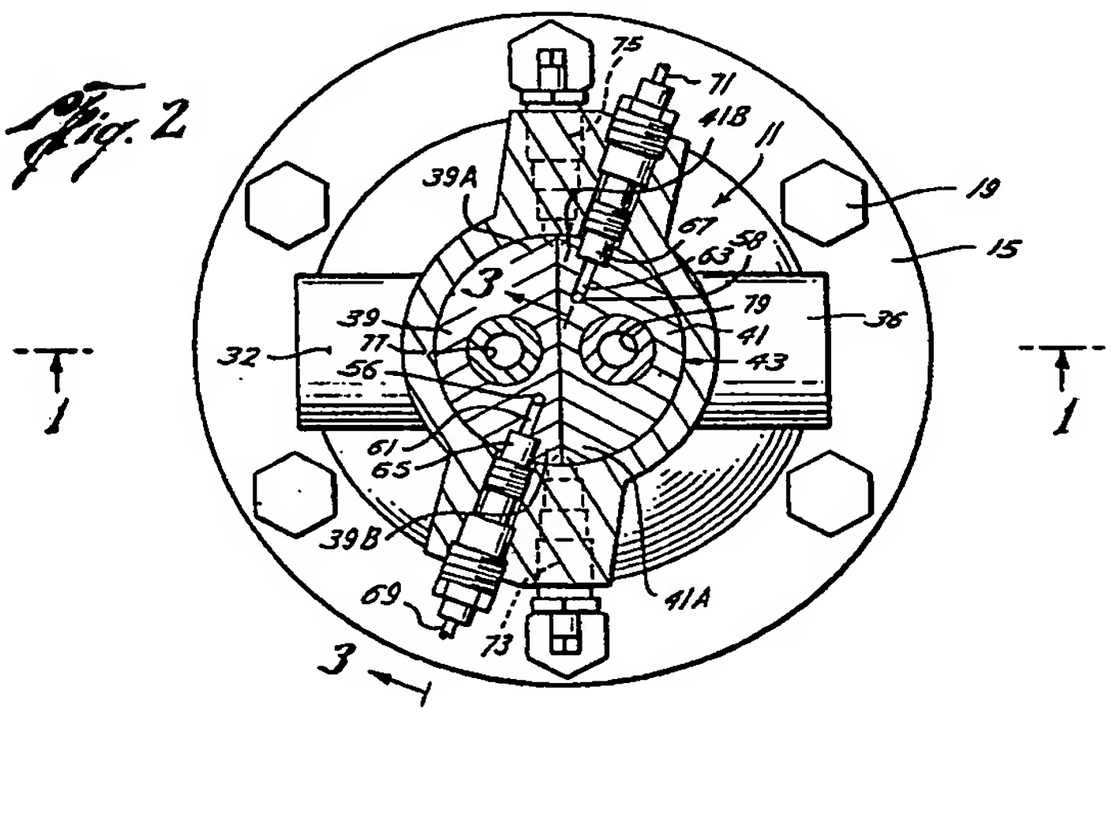


Fig. 2



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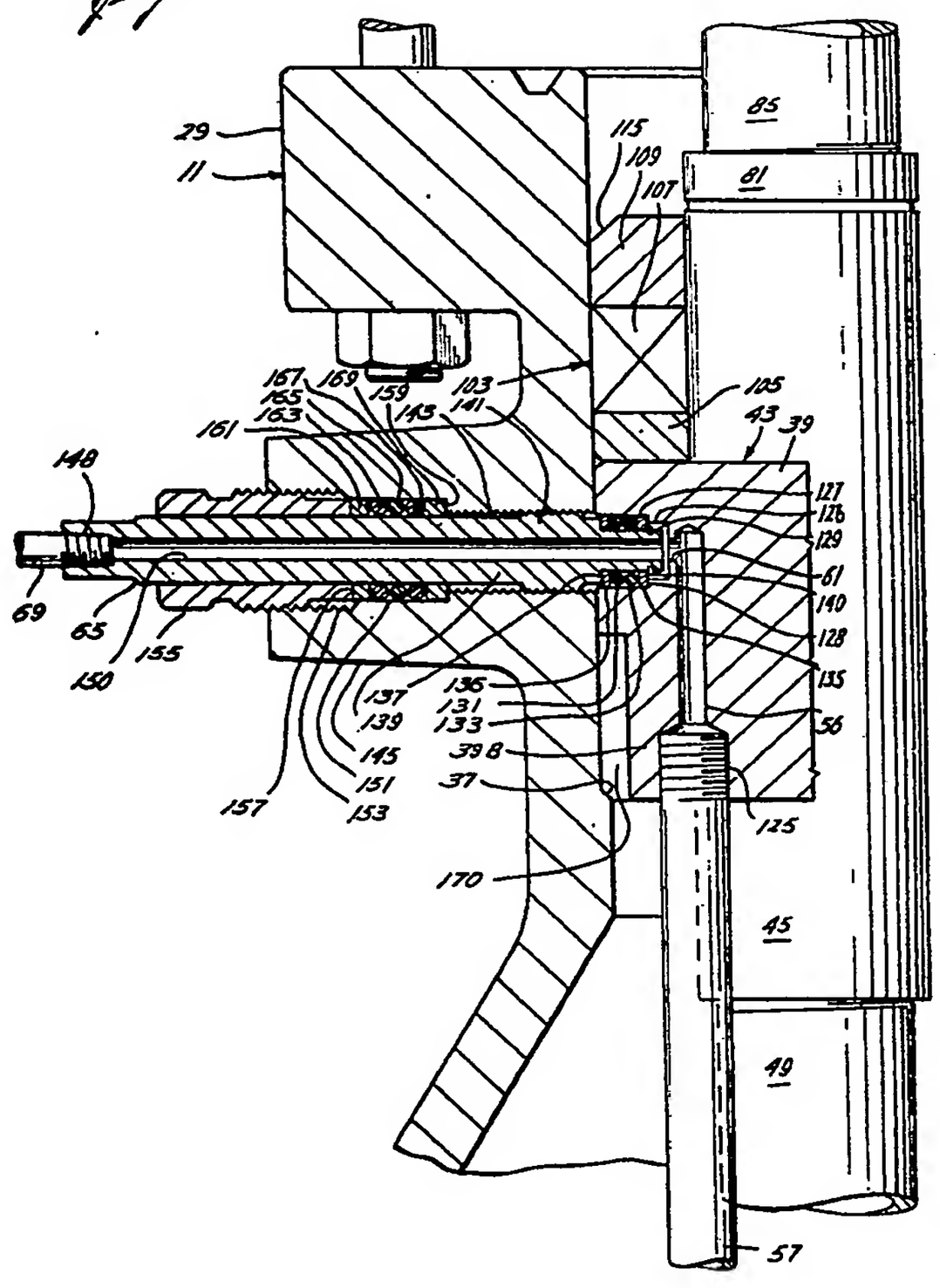
Sheet 2

Fig. 3



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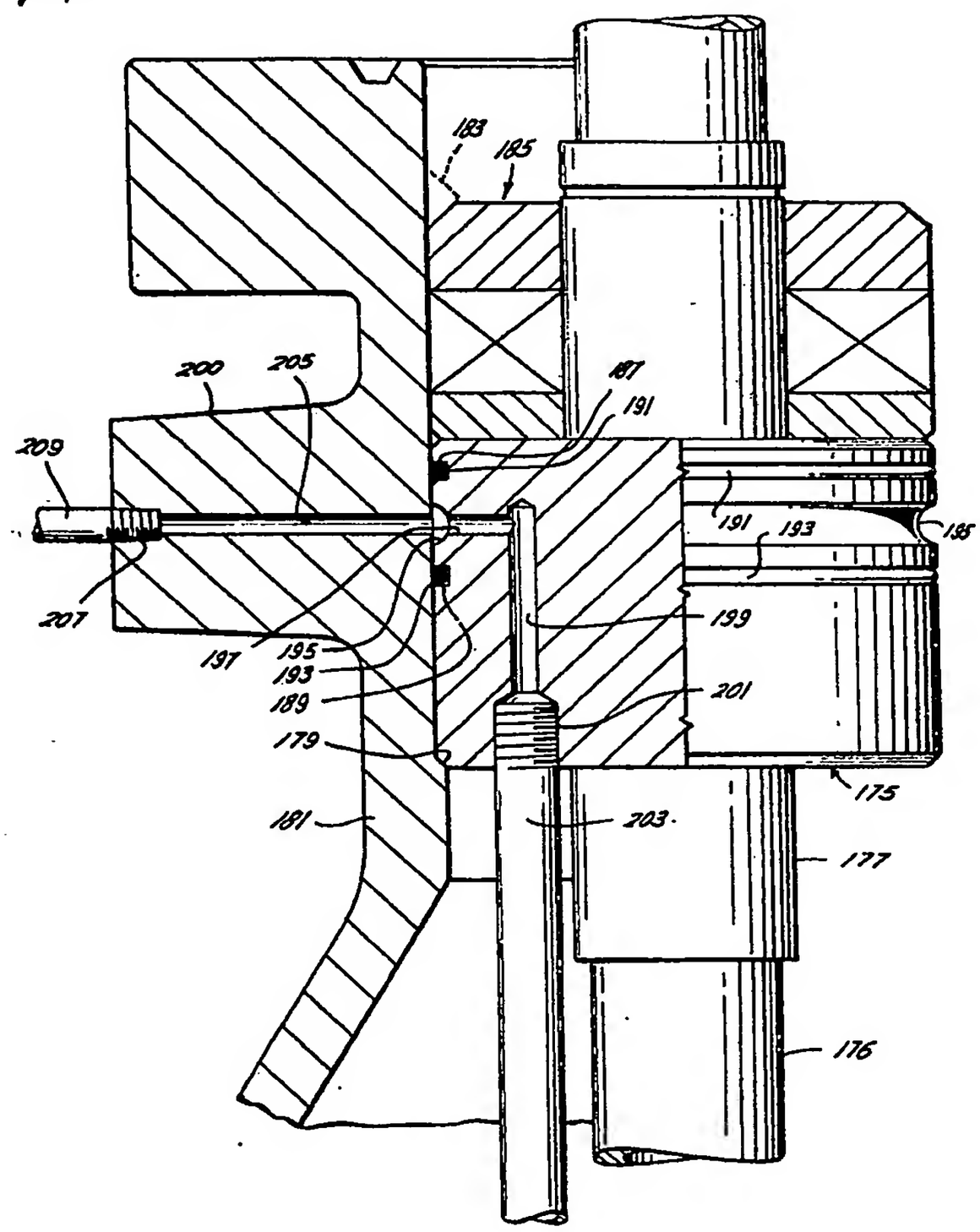
4 SHEETS

Fig. 4



1419850 COMPLETE SPECIFICATION
4 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 4

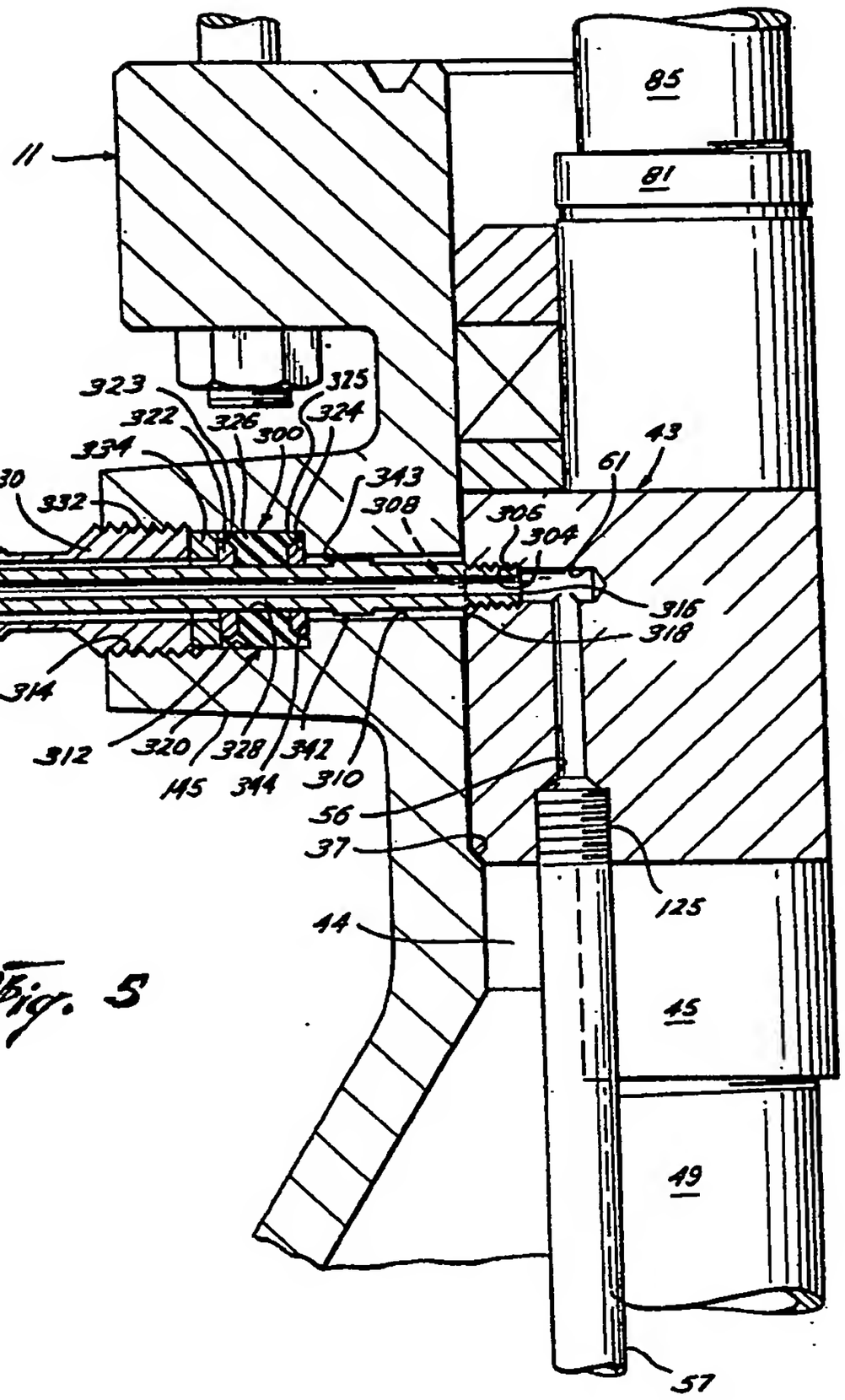


Fig. 5